

## CLAIMS

## WE CLAIM:

1. A method of operating a computer-implemented service comprising:  
providing an abstract location object arranged in a schema to enable servicing a received request for a logical location of an electronic endpoint; and  
arranging one or more location elements within the context of the abstract location object, the location elements configured to act as peers relative to the logical location, each location element configured to act as a proxy relative to any other location element within the abstract location object.
2. The method of claim 1 wherein the location elements include one or more of a position, an address, a spatial entity, and an electronic endpoint.
3. The method of claim 1 wherein each location element is capable of running autonomously without requiring an application using the abstract location object to be operable with each location element within the abstract location object.
4. The method of claim 3 wherein a resolver within the location service is configured to respond to requests from an application by populating the response with location elements according to information received by one or more location elements acting as proxies.
5. The method of claim 1 wherein the schema logically wraps disparate location elements to represent a given location.
6. The method of claim 1 wherein the schema enables a location object to be populated by different processes which understand different elements of a single structure.
7. The method of claim 1 wherein the electronic endpoint can include one or more of a wireless access point, an IP address, an email address, an Instant Message address, a phone number, a fax number as a logical location and location proxy.

8. The method of claim 1 wherein the schema is configured to hold multiple types of elements which represent a same logical location and can function as location proxies for each other.
9. The method of claim 8 wherein the elements are defined with attributes that include nested data types to provide a certainty of a location.
10. The method of claim 1 wherein the schema is configured via a hierarchical location aware data structure by providing one or more extensible abstract base classes independent of location data.
11. The method of claim 1 wherein the schema supports a location service, the schema being extensible and agnostic to a provider of location information and a technology used by the provider.
12. The method of claim 11 wherein the location service is one or more of a locally executed module and a distributed function of a computer network.
13. The method of claim 1 wherein the schema includes a Core.LocationElement data structure independent of location data, the Core.LocationElement data structure inheriting from one or more of a Location.IEEE802dot11, Location.NamedLocation, Location.Address, Location.Position, Location.EntityReference data structure.
14. The method of claim 13 wherein the Location.IEEE802dot11 data structure is configured to capture a media access control (MAC) address, receive signal strength indication (RSSI), service set identifier (SSID), and an uncertainty associated with an access point for an 802.11 type device.
15. The method of claim 13 wherein the Location.IEEE802dot11 data structure includes one or more of a MAC:nvarchar[1:1], RSSI:float[0:1], SSID:nvarchar[0:1] and Uncertainty:float[0:1].

16. The method of claim 13 wherein the Location.IEEE802dot11 data structure includes one or more of a MAC:nvarchar[1:1], RSSI:float[0:1], SSID:nvarchar[0:1] and Uncertainty:float[0:1].

17. The method of claim 13 wherein the Location.NamedLocation data structure interacts with a Location.EntityReference data structure to provide one or more of a link, URI and an entity in an entity database.

18. The method of claim 17 wherein the Location.EntityReference includes one or more of a Datasource:URI[0:1], DatasourceType:Category Ref[0:1], EntityID:nvarchar[1:1] and Parent:link[0:1].

19. The method of claim 1 wherein the schema includes a Location.CoordinateReferenceSystem that includes data identity coordinates, the data identity coordinates including one or more of a Code:int[1:1], CodeSpace:nvarchar[1:1], Edition:nvarchar[1:1], EngineeringReference:link[1:1], UnitAngle:nvarchar[0:1], UnitXY:nvarchar[0:1], and UnitZ:nvarchar[0:1].

20. The method of claim 1 wherein the schema includes a Location.Address data structure to provide a physical address of a location, the data structure including one or more of AddressLin:nvarchar[0:1], AdministrativeDivision:nvarchar[0:1], CountryRegion:nvarchar[0:1], Description:nvarchar[0:1], FormattedAddress:nvarchar[0:1], InternalAddressLines:nvarchar[0:1], PostalCode:nvarchar[0:1], PrimarCity:nvarchar[0:1], and SecondaryCity:nvarchar[0:1].

21. The method of claim 1 wherein the schema includes a Location.Position data structure to represent the location of a location in a coordinate system, the data including one or more of an Angle:Angle3D[0:1], CoordinateSystem:Link[1:1], Uncertainty:PositionUncertainty[1:1] and XYZ:Position3D[1:1].

22. The method of claim 1 wherein the schema includes a plurality of nested data structures holding one or more arrays and matrices of data in a hierarchical format to provide location data.

23. The method of claim 22 wherein the nested elements include one or more of Location.Angle3D, Location.Matrix3D, Location.Position3D, Location.PositionUncertainty, Location.NonScalarString1024, and Core.CategorizedNestedElement.
24. The method of claim 22 wherein the plurality of nested data structures further includes a data structure Location.StatisticalUncertainty configured to hold an array of data referring to a matrix for angle and point covariance.
25. The method of claim 22 wherein the nested elements includes a Location.SimpleUncertainty data structure configured to hold scalars AnglePrecision:float[1:1] and PointPrecision:float[1:1].
26. The method of claim 22 wherein the nested elements includes a Location.StatisticalUncertainty data structure configured to hold an array of data for a matrix for angle and point covariance, the Location.StatisticalUncertainty data structure including a AngleCovarianceMatrix:matrix3[0:1] and a PointCovarianceMatrix:matrix3x3[0:1].
27. The method of claim 22 wherein the nested elements includes a Core.LocationReport configured to capture data for the location service to determine a location and an uncertainty of the location.
28. The method of claim 27 wherein the Core.LocationReport includes Confidence:float[0:1] and CreationTime:datetime[1:1], the Core.LocationReport configured to inherit from data including a Core.CategorizedNestedElement and Categories:CategoryRef[0:\*].
29. A computer readable medium on which is stored a schema organized to store and provide location data, the schema comprising:
  - one or more extensible abstract base classes configured to hold location elements configured to act as peers relative to a logical location, each location element configured to act as a proxy relative to other location elements in the schema, each abstract base

class responsive to a plurality of applications to provide and store location data in the schema, including unrecognized types of location information; and

a hierarchical data structure including the abstract base classes, the hierarchical data structure configured to enable formation of a location object.

30. The computer readable medium of claim 29 wherein the hierarchical data structure and the abstract base classes enable storing the schema in memory-limited devices.

31. The computer readable medium of claim 29 wherein the extensible abstract base class is represented by a Core.LocationElement data structure independent of location data, the Core.LocationElement data structure inheriting from one or more of a Location.IEEE802dot11, Location.NamedLocation, Location.Address, Location.Position, Location.EntityReference data structure.

32. The computer readable medium of claim 29 wherein the schema includes a Location.Address data structure to provide a physical address of a location, the data structure including one or more of AddressLin:nvarchar[0:1], AdministrativeDivision:nvarchar[0:1], CountryRegion:nvarchar[0:1], Description:nvarchar[0:1], FormattedAddress:nvarchar[0:1], InternalAddressLines:nvarchar[0:1], PostalCode:nvarchar[0:1], PrimarCity:nvarchar[0:1], and SecondaryCity:nvarchar[0:1].

33. The computer readable medium of claim 29 wherein the schema includes a Location.Position data structure to represent the location of a location in a coordinate system, the data including one or more of an Angle:Angle3D[0:1], CoordinateSystem:Link[1:1], Uncertainty:PositionUncertainty[1:1] and XYZ:Position3D[1:1].

34. The computer readable medium of claim 29 wherein the schema includes a plurality of nested data structures holding one or more arrays and matrices of data in a hierarchical format to provide location data, the nested data structure configured to be responsive to the base classes to load location data when needed.

35. The computer readable medium of claim 34 wherein the nested elements include one or more of `Location.Angle3D`, `Location.Matrix3D`, `Location.Position3D`, `Location.PositionUncertainty`, `Location.NonScalarString1024`, and `Core.CategorizedNestedElement`.
36. The computer readable medium of claim 34 wherein the plurality of nested data structures further includes a data structure `Location.StatisticalUncertainty` configured to hold an array of data referring to a matrix for angle and point covariance.
37. The computer readable medium of claim 34 wherein the nested elements includes a `Location.SimpleUncertainty` data structure configured to hold scalars `AnglePrecision:float[1:1]` and `PointPrecision:float[1:1]`.
38. The computer readable medium of claim 34 wherein the nested elements includes a `Location.StatisticalUncertainty` data structure configured to hold an array of data for a matrix for angle and point covariance, the `Location.StatisticalUncertainty` data structure including a `AngleCovarianceMatrix:matrix3[0:1]` and a `PointCovarianceMatrix:matrix3x3[0:1]`.
39. The computer readable medium of claim 34 wherein the nested elements includes a `Core.LocationReport` configured to capture data for the location service to determine a location and an uncertainty of the location.
40. The computer readable medium of claim 39 wherein the `Core.LocationReport` includes `Confidence:float[0:1]` and `CreationTime:datetime[1:1]`, the `Core.LocationReport` configured to inherit from data including a `Core.CategorizedNestedElement` and `Categories:CategoryRef[0:*]`.
41. A computer system comprising:  
     a processor; and  
     a memory coupled to the processor, the memory storing a plurality of hierarchically arranged data structures in a schema the hierarchical data structures configured to provide one or more extensible abstract base classes configured to retrieve

and provide location data of a logical location, the abstract base classes responsive to a plurality of applications to provide and store location data in the schema, including unrecognized types of location data, the schema configured to enable servicing a received request for a logical location of an electronic endpoint, the schema configured as an abstract location object with the location elements configured to act as peers relative to the logical location, each location element configured to act as a proxy relative to other location elements within the abstract location object.

42. The computer system of claim 41 wherein the location data includes one or more of an 802.11 type provider, a network location awareness (NLA) provider, a global position service (GPS) provider, a General Packet Radio Service (GPRS) provider data, and a Bluetooth provider.

43. The computer system of claim 41 wherein the schema includes a plurality of nested data structures holding one or more arrays and matrices of data in a hierarchical format to provide location data, the nested elements include one or more of Location.Angle3D, Location.Matrix3D, Location.Position3D, Location.PositionUncertainty, Location.NonScalarString1024, and Core.CategorizedNestedElement, Location.Angle3D, Location.Matrix3D, Location.Position3D, Location.PositionUncertainty, Location.NonScalarString1024, and Core.CategorizedNestedElement.

44. The computer system of claim 41 wherein the schema includes a plurality of nested data structures holding one or more arrays and matrices of data in a hierarchical format to provide location data, the nested elements including a data structure Location.StatisticalUncertainty configured to hold an array of data referring to a matrix for angle and point covariance.

45. The computer system of claim 41 wherein the schema includes a plurality of nested data structures holding one or more arrays and matrices of data in a hierarchical format to provide location data, the nested elements including a Location.SimpleUncertainly data structure configured to hold scalars AnglePrecision:float[1:1] and PointPrecision:float[1:1].